CLAIMS

1. A system for cleaning raw coal including:

a supply of raw coal containing clean coal and debris;

a supply of magnetic particles;

a vibratory separator for receiving a quantity of the raw coal and a quantity of the magnetic particles, said magnetic particles creating a fluidized bed which separates the clean coal from the debris, and for discharging the clean coal from the vibratory separator separately from a remaining mixture of the magnetic particles and debris; and

a magnetic separator for receiving the mixture of magnetic particles and debris from the vibratory separator and separating the magnetic particles from the debris.

2. The system defined in claim 1 wherein the supplies of raw coal and magnetic particles are stored in first and second hoppers, respectively.

3. The system defined in claim 2 including a conveyor for transporting the raw coal from the first hopper to the vibratory separator.

4. The system defined in claim 1 including a chute for removing the magnetic particles from the magnetic separator and a conveyor for returning the separated

magnetic particles removed from the magnetic separator back into the supply of magnetic particles.

5. The system defined in claim 4 wherein the conveyor includes a section of a belt conveyor and a section of a bucket conveyor.

6. The system defined in claim 1 wherein the vibratory separator includes at least one rotary vibrator, a separating chamber and a scraper plate.

7. The system defined in claim 6 wherein the separating chamber includes an inlet for receiving a quantity of the raw coal and magnetic particles, and an outlet; and in which the scraper plate is located adjacent the outlet and is in communication with first and second discharge ducts located at said outlet, and wherein said first duct receives the mixture of magnetic particles and debris and the second duct receives the clean coal.

8. The system defined in claim 7 wherein the first and second ducts have an open side which communicates with the magnetic separator.

9. The system defined in claim 1 wherein the magnetic separator includes a rotating drum having a generally non-magnetic outer surface and a magnet located within the drum and extending along only a portion of the drum.

10. A method of cleaning raw coal including the steps of:

mixing a quantity of raw coal containing clean coal and debris with a quantity of magnetic particles;

feeding the mixture of magnetic particles and raw coal into a vibratory separator with the magnetic particles creating a fluidized bed to separate clean coal from the debris.; and

removing the clean coal from the vibratory separator.

11. The method defined in claim 10 including the further step of removing the magnetic particles and debris from the vibratory separator and feeding the magnetic particles and debris into a magnetic separator; and separating the magnetic particles from the debris in said magnetic separator.

12. The method defined in claim 11 including the step of removing the magnetic particles from the magnetic separator; and returning the separated magnetic particles to a supply of magnetic particles for subsequent mixing with the raw coal.

13. The method defined in claim 12 including the step of storing a supply of the magnetic particles in a hopper; and providing a conveyor for returning the separated magnetic particles from the magnetic separator into the supply of magnetic particles.

14. The method defined in claim 11 wherein the step of separating the magnetic particles from the debris further includes the steps of providing a rotating drum having a non-magnetic outer surface; providing a magnetic field adjacent a portion of said drum surface; moving the stream of debris and magnetic particles through the magnetic field as the drum rotates whereby the magnetic particles are attached by the magnetic field and separate from the debris and temporarily adhere to a portion of the drum's outer surface adjacent the magnetic field; and moving the said portion of the drum outer surface past the magnetic field to remove the adhered magnetic particles therefrom.

15. Apparatus for erection at a coal mining site to separate clean coal from raw coal containing the clean coal and debris without the use of water, said apparatus comprising:

a first hopper for receiving a supply of the raw coal;

a second hopper for receiving a supply of magnetic particles;

a mechanical separator for receiving predetermined quantities of the raw coal and magnetic particles and for creating a fluidized bed from the magnetic particles to separate the clean coal from the magnetic particles and debris;

a first conveyor for delivering a supply of the raw coal to the mechanical separator;

a magnetic separator for receiving the magnetic particles and debris from the mechanical separator, and for separating the magnetic particles from the debris; and

a second conveyor for delivering the magnetic particles separated in the magnetic separator back into the second hopper.

16. The apparatus defined in claim 15 wherein the mechanical separator is a vibratory separator including a rotary vibrator, a shaker table for receiving the raw coal and magnetic particles for creating the fluidized bed of magnetic particles to separate the clean coal from the debris; and a scraping plate for removing the clean coal from the magnetic particles and debris.

17. The apparatus defined in claim 15 wherein the magnetic separator includes a rotating drum having a non-magnetic outer surface and a magnet located within the drum and extending along only a portion of the drum outer surface.

18. The apparatus defined in claim 15 wherein the magnetic particles are magnetic.

19. The apparatus defined in claim 18 wherein the magnetic particles are substantially spherical having a size in the general range of between 150 and 500 microns.

20. A magnetic separator for separating magnetic particles from debris including a rotating drum having a non-magnetic outer surface; a magnet located within the drum and extending along a portion of the drum to provide a magnetic field adjacent said portion of the drum; a duct for directing the magnetic particles and debris along the said portion of the drum whereby said magnetic particles are attached toward the magnet and temporarily adhere to the said portion of the drum adjacent the magnet; and a collector located adjacent the drum for collecting the magnetic particles as the said portion of the drum rotates beyond the magnet.

21. The magnetic separator defined in claim 20 wherein the magnet is an arcuate-shaped permanent magnet mounted in a fixed position within the rotating drum.

22. The magnetic separator defined in claim 21 wherein the magnet extends through an arc of less than 180°.

23. The magnetic separator defined in claim 20 wherein the duct has an upper inlet for receiving the magnetic particles and debris and a lower outlet to remove the debris by gravity from the magnetic separator.

24. A vibratory separator for separating two materials having different specific gravities from a mixture of said materials including:

a chamber having an inclined substantially non-perforated plate for receiving a quantity of said mixture;

a supply of particles capable of forming a fluidized bed when subjected to vibration in the chamber;

a vibrator for vibrating the inclined plate to create a fluidized bed of the particles within the chamber whereby the lighter of said two materials floats on the fluidized bed; and

a divider for removing the lighter material from the chamber as the fluidized bed and materials move along the inclined plate.

25. The vibratory separator defined in claim 24 wherein the divider is a scraper plate positioned adjacent a discharge opening of the chamber.

26. The vibratory separator defined in claim 24 wherein the inclined plate is located within an outer housing; in which the vibrator is a rotary electric vibrator mounted on said housing; and in which the housing is supported by resilient members.

27. A method for separating two materials having different specific gravities from a mixture of said material without the addition of water, including the steps of:

mixing a quantity of the mixture with a quantity of dry particles capable of forming a fluidized bed when vibrated;

feeding the mixture and particles into a vibratory separator with the particles creating a fluidized bed to separate the two materials; and

removing the material with the lower specific gravity from above the fluidized bed and from the vibratory separator.

28. The method defined in claim 27 including the step of feeding the material with the higher specific gravity and particles into a second separator for removing the particles from said higher specific gravity material.

29. The method defined in claim 28 including the steps of forming the particles of a magnetic material; providing the second vibrator with a magnetic field; and attracting the magnetic particles toward the magnetic field to remove said particles from the material having the higher specific gravity.

30. The method defined in claim 29 including the steps of removing the magnetic particles from the second vibrator for subsequent mixing with another quantity of the material mixture.